



**Heliophysics Advisory
Committee**

Framework for HPAC Feedback to Research and Analysis (R&A) Charge

**HPAC Meeting
April 5-6, 2018**

Overall Summary of Feedback

- High Impact/High Risk projects: We define these as those projects that will "rewrite the textbooks." We recommend starting at ~5% dedicated to these projects, with program evaluations to adjust this in future years. We recommend that review panelists undergo special training on evaluating this type of proposal. We recommend "lessons learned" final reports in addition to technical outcomes, made public so others can understand and build on the work. We are split on whether to have a separate call or not, perhaps even both approaches could be implemented, and perhaps even have a special procurement process for such projects.
- Interdisciplinary/interdivisional projects: we suggest that SMD "go slowly and adjust." Start with perhaps ~1% of R&A Divisional budgets devoted to interdivisional research. We identified many examples of how Heliophysics researchers could contribute to interdivisional work. Interdisciplinary work should be identified by the proposer for special consideration by the panel. We are split on whether to have a separate ROSES-E call for these projects or have them submitted through regular ROSES elements in A-D, but designated by the proposer as interdivisional. Perhaps both approaches could be implemented.

Question 1

1. Does the SMD R&A program have processes in place to effectively solicit, review and select high-impact/high-risk projects?
 - a) What is your committee's working definition of a high-impact project? A high-risk project?
 - b) Are there aspects of the solicitation, review and selection process that could be added, removed or modified that would allow SMD to more effectively elicit and support high-risk/high-impact projects or, is the current practice of soliciting by topic and evaluation for merit followed by flagging high-impact/high-risk projects for the selection official adequate?
 - c) If it were to be recommended that solicitations or evaluation methods be modified for high-impact/high-risk projects, how should these be designed?
 - d) Acknowledging the value of incremental progress on achieving strategic objectives, and thus recognizing that much of the research that SMD supports will be of moderate impact, how should SMD determine the correct balance between moderate impact research and high-impact/high-risk research?

a) What is your committee's working definition of a high-impact project? A high-risk project?

- **High-Impact/High-Risk research:** A project that has a low/uncertain probability of success and whose outcome, if confirmed, would "rewrite the textbook," significantly impacting current thinking, methods or practice. The idea may be counter to the existing scientific consensus, there may be scant precedent or preliminary data to support it, or the methodology for testing it may not be clearly established, but it is not clearly false, and could be worth examining seriously.

b) Are there aspects of the solicitation, review and selection process that could be added, removed or modified that would allow SMD to more effectively elicit and support high-risk/high-impact projects or, is the current practice of soliciting by topic and evaluation for merit followed by flagging high-impact/high-risk projects for the selection official adequate?

- There is universal agreement the high-impact /high-risk (HI/HR) research is vitally important to a healthy, well-balanced science program. However, such research is at a competitive disadvantage in the current environment of very low proposal selection rates. Reviewers are reluctant to risk precious funds on projects that are deemed unsafe (not likely to have a clear, positive outcome), and proposers are therefore hesitant to propose such projects. Perhaps this culture can be changed with clear instructions to both proposers and reviewers that HI/HR efforts are to be treated as a valued component of the research portfolio. It may instead be necessary to create a new HI/HR program line, perhaps as a subset of Supporting Research (SR).
- Yes, HI/HR projects should be flagged by the proposer as a project in this category, and then be for special assessment.
- Train reviewers to recognize cognitive biases that might lead to, for instance, under-selection of risky proposals, new PIs' proposals, and proposals that use old data or focus on continuity.
- The appropriate funding level for this line is a difficult question that is addressed in part d. We recommend that the funding start small and increase based on a regular evaluation of the program. The evaluation process and related metrics must be carefully thought through. We also recommend that the funding level in any given year not be pre-set before the reviews are completed. Fundable HI/HR proposals should be compared against fundable SR proposals, and money transferred between the programs so that the best science is supported. This could be accomplished by, for example, having the review panels or subsets thereof meet jointly by telecom or in person after the initial reviews have been completed. In addition to guaranteeing that the best science is supported, this second step will insure that "misplaced" proposals at the cusp of HI/HR are treated fairly.

c) If it were to be recommended that solicitations or evaluation methods be modified for high-impact/high-risk projects, how should these be designed?

- Suggestion to have a separate call for High-Impact Venture projects
 - Enables customized instructions and evaluation criteria
 - Evaluators trained and coached in evaluating proposals from the mindset of an investor
 - Best value as oppose to Technical-Cost-Schedule
- We are also recommending that NASA consider having the HI/HR projects be handled within the regular ROSES calls, but be flagged by the proposer as HI/HR and assessed separately.
 - Evaluators would still need to be trained and coached to evaluate this type of proposals.
- Proposals should include a “lessons learned” final report, regardless of the outcome of the project.
 - These reports should be made publicly available so that future proposers and reviewers of HI/HR projects are aware of these lessons.
- Proposal review panels should have a post-panel debrief to discuss their lessons learned about evaluating HI/HR proposals.
- On the next slide is a list of suggestions for streamlining the process for HI/HR projects that involve spaceflight hardware.

More on streamlining hardware projects

- Additional thoughts on streamlining the process for HI/HR projects, especially hardware contracts involving procurement and contract deliverables:
 - Leverage OTA/SAA and public-private partnerships to develop capabilities prior to transition to full FAR procurement
 - Enables incremental development of concepts and technologies that can be transitioned to FAR type procurements
 - See COTS/CRS and AF SMC SpEC
 - NASA COTS SAA was a high impact venture prepared for “failures”
 - Raise TRL of concepts that would otherwise not advance to award
 - Consider a multi-step procurement
 - White paper submission guide downselect to a limited proposal group
 - Further downselect can occur after demonstration mission

d) Acknowledging the value of incremental progress on achieving strategic objectives, and thus recognizing that much of the research that SMD supports will be of moderate impact, how should SMD determine the correct balance between moderate impact research and high-impact/high-risk research?

- High-impact/high-risk research is an important part of a healthy research portfolio. For perspective, the National Academies report “Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future” from 2005 included a recommendation that at least 8% of the federal research budget should be allocated for high-risk, high payoff research. While this sets a baseline, this rate is somewhat higher than what is being carried out at comparable agencies. In particular, the ARPA-E program at the Department of Energy (DOE) is approximately 5.5% of the DOE Office of Science budget from FY17 and FY18.
- We recommend NASA SMD invests approximately 5% of its research budget on high-impact/high-risk research, and suggest this is done by all divisions together rather than by each division separately.
 - This percentage should be regularly evaluated regarding proposal pressure and outcomes from this program.
- Further, modeled after the National Institutes of Health (NIH) Pioneer Award and New Innovator Award, we recommend that a portion of the high-impact/high risk funding be offered separately to junior researchers.
- We recommend a full range of proposal sizes be considered.

Question 2

2. Does the SMD R&A program have effective processes in place to solicit, review and select focused, interdisciplinary, and interdivisional projects?
- a) How should SMD determine the right balance between division-specific and interdivisional research?
 - b) Once determined, does SMD have effective processes in place to achieve this balance?
 - c) How should each of SMD's divisions determine the right balance between discipline-focused and interdisciplinary research?
 - d) Once determined, do SMD's divisions have effective processes in place to achieve this balance?
 - e) Is SMD missing out on important interdisciplinary and/or interdivisional work because of the way in which we solicit, review, and select projects? If so, what specific research foci are missing?
 - f) Are there aspects of the solicitation, review and selection process that could be added, removed, or modified that would allow SMD to more effectively elicit and support interdisciplinary and or interdivisional projects?
 - g) If it is recommended that solicitations or evaluation methods be modified for interdisciplinary and/or interdivisional projects, how should these be designed?
 - h) What role, if any, should collaborative research structures such as NIH-style "Program-Project" grants, virtual institutes (the NASA Astrobiology Institute (NAI) and Solar System Exploration Research Virtual Institute (SSERVI)) and research coordination networks (the Nexus of Exoplanetary System Science (NExSS)) play?

a) How should SMD determine the right balance between division-specific and interdivisional research?

- The HPAC's main advice on this topic: go slowly and adjust. We recommend that SMD start from a low-level but reasonable allocation across disciplines in each Division, (order of ~1% of the R&A budget/year, per Division, the exact amount being in each Division's discretion) which is to be pooled towards selections of interdivisional proposal calls once per year. Depending on proposal quality, and number (proposal pressure), as well as peer evaluation of 1st year's program performance, decide on whether to continue, augment, or discontinue the program. Proposal selections could be tracked to ensure return on investment to divisions as a ~3 year average.
- This allows NASA and the community a vehicle to test and augment, at a low cost but some flexibility. Proposals are competed against each other, not within a discipline (which may place them at a disadvantage). Peer reviews to be conducted with different guidelines that are emphasizing interdivisional, and cross-cutting nature of research that has no home in one of the traditional disciplines' calls.

b) Once determined, does SMD have effective processes in place to achieve this balance?

- The right balance between division-specific and interdivisional research should not be mandated in advance. It would be reasonable to begin at a modest level and go slow, respecting the guidance obtained by community response and interest, while affording both the Divisions and the SMD appropriate input concerning demand on funding and selections.
- One option would be to introduce a new program under Program Element E, Cross-Division Research, to accommodate evaluation of these proposals. This element would have a separate call and cross-divisional review panel.
- There is another approach that could be implemented. If proposals are submitted to the Division-specific ROSES elements (A through D), it would be straightforward for proposers to indicate (using a pull-down menu) that their proposal contains cross-disciplinary or multidisciplinary content. These proposals as well as others flagged as cross-divisional or interdisciplinary, may be evaluated by normal panels at the Divisional level for scientific quality from the Divisional perspective. Those proposals judged to be of sufficient quality can be passed up to SMD for further evaluation, possibly by a special cross-divisional panel that meets as needed. In this way, Divisional priorities can be balanced with community interest, while placing the SMD in a position to control final cross disciplinary selections using a proper mix of expertise. Proposals judged as “homeless” at the Division level would be steered towards possible homes at the SMD level.

c) How should the Heliophysics Division determine the right balance between discipline-focused and interdisciplinary research?
d) Once determined, does HPD have effective processes in place to achieve this balance?

- SMD divisions have established the balance between discipline-focused research areas through fund allocation amounts to each and independent processes to determine successful proposals. In future announcements for each discipline-focused area, there should be an extra additional statement welcoming interdisciplinary proposals. Such proposals should be evaluated by a panel informed by mail-in reviews employing an appropriate balance of discipline experts. As an initial measure, interdisciplinary proposal funding should be initially ~5% of total divisional research resources. After three years, the percentage invested in interdisciplinary research should be reviewed and modified if needed. Note that there was not consensus from the HPAC on this initial investment amount, with some recommending that the balance should be determined based on merit review in the proposal review panel. Finally, as a suggestion for implementation, there could be a designation in the Program Specific Data section for proposers to identify their proposed study as interdisciplinary.

e) Is SMD missing out on important interdisciplinary and/or interdivisional work because of the way in which we solicit, review, and select projects? If so, what specific research foci are missing?

- There is important multi- and interdisciplinary and –divisional work that SMD is neglecting because there are no mechanisms to solicit or properly evaluate such proposals. Often, but particularly for interdivisional proposals, the solicitation to which proposers should respond is unclear. Difficulties also arise in the review panel. Because the current success rate is so low, those proposals that are focused only on the division or discipline objectives are often ranked higher than those that have cross disciplinary goals. The conventional wisdom is that review panels are reluctant to rate such proposals high because some funds would be used to support goals from outside the program.
- Examples of poorly represented research areas are on the next slide.

Examples of poorly represented research areas:

- Astrophysics/Heliophysics
 - Effects of gamma ray bursts on terrestrial lightning from Fermi observatory which is an Astrophysics mission);
 - How magnetic fields are distributed on the surface of cool stars, and the evolution of these fields;
 - How mass loss, angular momentum loss, spin down rates, etc. from the winds are affected by the coronal field geometry;
 - How the observed disk-integrated Ca II, Mg II, X-ray fluxes, etc. are produced;
 - What flares and CMEs on other stars might look like, and how these dynamic events might affect the habitability of exoplanets (also Planetary Science Division).
- Planetary/Heliophysics
 - Study of space environment around planet (e.g. magnetic reconnection and particle acceleration at Mercury or other planets);
 - What flares and CMEs on other stars might look like, and how these dynamic events might affect the habitability of exoplanets (also Astrophysics Division);
 - Interactions between dust (<10 μm) and plasmas (also Astrophysics Division).
- Earth Science/Heliophysics (except occasional LWS sun-climate opportunities)
 - Science across the stratopause: top-down and bottom-up forcing.
- Any Two Divisions
 - Changing the observing mode on one division's mission to a target in a different division

f) Are there aspects of the solicitation, review and selection process that could be added, removed, or modified that would allow SMD to more effectively elicit and support interdisciplinary and or interdivisional projects?

- Possible strategies for more effectively soliciting, reviewing, and selecting interdisciplinary or interdivisional projects include:
- Solicitation targeting interdisciplinary proposals
 - Buy-in (budget) from the different programs/divisions
 - Panel members chosen for their interdisciplinary expertise
 - A “homeless” website could list interdisciplinary questions that the solicitation would target
- Standard solicitation, but flag the interdisciplinary proposals
 - PI identifies multiple programs/divisions on the proposal summary page
 - Proposal describes benefits to the identified programs
 - Proposal is placed into “homeless” category and discussed by relevant program managers and/or reviewed by interdisciplinary “homeless” panel
 - Buy-in (budget) from the different programs/divisions

g) If it is recommended that solicitations or evaluation methods be modified for interdisciplinary and/or interdivisional projects, how should these be designed?

- In announcements it can be specified that interdisciplinary and interdivisional research is allowed provided that the research makes a valuable contribution to the discipline or division to which it is submitted. This would need to be reflected in the review of the proposals as well such that the review panel knows this research is compliant if well justified.
- When proposals are submitted to NSPIRES system under program specific data there can be options to specify the type of research as interdisciplinary or interdivisional and select the other division or discipline. This will help the program managers find qualified reviewers, and provide information to NASA on how much interdisciplinary and interdivisional research is being done. This also will allow the different divisions to determine if they want to work together to fund a project.
- While there was not consensus on this within HPAC, a suggestion is that there could be a full separate panel for evaluating interdivisional proposals.

h) What role, if any, should collaborative research structures such as NIH-style “Program-Project” grants, virtual institutes (the NASA Astrobiology Institute (NAI) and Solar System Exploration Research Virtual Institute (SSERVI)) and research coordination networks (the Nexus of Exoplanetary System Science (NExSS)) play?

- The plan for the Drive Science Centers is quite similar to these, and can be utilized for this type of collaborative research, at least for interdisciplinary research within HPD. HPD should assess the outcomes and lessons learned from these Centers on interdisciplinary project teams.
- On interdivisional institutes and centers, HPAC doesn't have enough information to assess the current activities, and therefore cannot address the effectiveness and necessity for such institutes.